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Reconciliation of Processed Catch Statistics with Log Data for 1992-97 Flatfish in 4vwx/5y

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ABSTRACT

During recent years (1992-97), 30-60% of Scotia-Fundy area landings are represented in the Commercial Landings database as unspecified flounder. This creates difficulties when attempting to assess stock status of individual species (American plaice, winter flounder, witch flounder, yellowtail flounder) where the unspecified portion of the landings acts as an ambiguous catch-all for much of the catch. An investigation of Fishing Log data demonstrated that major quantities of the catch of unspecified flounder in the Commercial Landings database were attributable to default coding of species during processing, in that identified species in the Fishing Log database were portrayed as unspecified flounder in the Commercial Landings database. A new database was derived from these two sources to compare depictions of flatfish landings, and make adjustments to the Commercial Landings based on Fishing Log data. These adjusted landings reduced the unspecified flounder to 10-40% of the flatfish catch (less than 15% since 1994). Several differences in apparent fishery trends (annual landings, catch distributions, catch rates) between the Commercial and adjusted landings were examined. The representations of catch by species between data sources were not proportional, with the Commercial and adjusted landings giving very different pictures of several fisheries.

RÉSUMÉ

Au cours des dernières années (1992-1997), de 30 à 60 % des débarquements en provenance de la région de Scotia-Fundy sont mentionnés dans la base de données des débarquements commerciaux comme étant des plies non spécifiées. Cela crée des difficultés au moment de l'évaluation des stocks d'espèces particulières (plie canadienne, plie rouge, plie grise et limande à queue jaune) car la partie non spécifiée des débarquements constitue un groupe général indéfini appréciable de la grande majorité des captures. Un examen des données des registres de pêche a montré que la plus grande partie des captures indiquées comme étant des plies non spécifiées dans la base de données des débarquements commerciaux résultait d'un codage par défaut d'espèces pendant la transformation car les espèces identifiées dans la base de données des registres de pêche étaient présentées comme étant des plies dans la base de données des débarquements commerciaux. Une nouvelle base de données a été produite à partir de ces deux sources afin de comparer les descriptions des débarquements de poissons plats et d'apporter des corrections aux débarquements commerciaux fondées sur les données des registres de pêche. Ces débarquements corrigés ont permis de réduire le nombre de plies non spécifiées à un niveau de 10 à 40 % des captures de poissons plats (à moins de 15 % depuis 1994). Divers écarts des tendances apparentes de la pêche (débarquements annuels, distribution des captures et taux de capture) entre les débarquements commerciaux et les débarquements corrigés ont été examinés. Les représentations des captures par espèces entre les sources de données n'étaient pas proportionnelles, les débarquements commerciaux et corrigés donnant des images très différentes de plusieurs pêcheries.

Introduction

Throughout the 1990's the DFO Commercial Landings database identified 30-60% of Scotia-Fundy region catches of American plaice, winter and yellowtail flounder under the generic category of unspecified flounder. As a result, only the remaining component of the flatfish catches, those identified to the species level in the Commercial Landings data, have been used for resource evaluations of these three species. Interpretations of the status and exploitation of these resources have been compromised. Where the relative proportions of the three species caught, as inferred by identified landings, differ from proportions of these species within the unspecified landings, any assessment based on such data would be correspondingly biased. As a result, recent assessments have relied heavily on the interpretation of Research Survey data (survey abundance estimates, length-frequency trends, catch rates), with the Commercial Landings providing only some supporting evidence through analysis of catch rates by selected fishery components represented by identified flatfish catches. This provides insufficient collaboration among fishery data sources to assess the status of these stocks with confidence, even when they agree with one another.

Various reasons have been tabled as to why unspecified flounder represents so large a portion of the Commercial Landings data. The commonest explanation has been that historically no price differential existed between species, so fishermen/processors rarely bothered to separate flatfish catches by species (all flatfish go in the same hold compartment/bucket). The inference was that observers for the Dockside Monitoring Program (DMP) found themselves weighing out buckets of mixed flatfish, and DMP weighout is the standard source of species identification for Commercial Landings data. It appears that this may have been a reasonable depiction of the situation prior to the 1990's, but that it may currently be less valid than the Commercial Landings data would suggest. Several questions and concerns have been raised about the transcription and processing of flatfish landings. Chief among these are:

1) Fishermen reasonably estimate the species mix of their catches in their logbooks. These data have been ignored due to concern that catches may be misreported, accidentally or deliberately. Accidental misreporting could be either misidentification by Industry of a species with respect to DFO nomenclature, or incorrect translation of local nomenclature by DFO/DMP staff to DFO nomenclature.

2) Contentions that some DMP observers habitually record flatfish catches as unspecified, even when the catch had been sorted by species prior to weighout.

3) A question as to the likelihood of several species being mixed in a single bucket when enough of a single species had been caught to completely fill a bucket, or enough of a species to warrant separation for reasons of pricing or processing.

Suppositions include a) the fish plant would want discrete buckets to speed processing, and b) in recent years their have been differences in value between flatfish species.

Given the desirability of obtaining Commercial Landings data associated with correct species assignments, we undertook an investigation into the relationships between the Commercial Landings data and computerized logbook (Fishing Log) data for recent years (1992-1997).The main goal was to reconstruct commercial landings of the major commercial flatfish stocks of American plaice, winter flounder, yellowtail flounder, and witch flounder where the processed Commercial Landings data record unspecified flounder. A secondary objective was an examination of differences in species identity between the Commercial Landings data and the Fishing Log data in instances where species were named.

Methods

LANDINGS DATA

Initial extractions of flatfish catches were taken from computerized trip details and catch estimates Fishing Log data, and from Commercial Landings data, for 1992-97. The 1991 data could also be analysed but was unavailable when we constructed our datasets. The 1998 data was incomplete when this analysis was conducted, so was not included. For each year, the Fishing Log and Commercial Landings data files were merged to create a single data file of estimated 4VWX/5Y (see Figure 1 for NAFO unit area locations) flatfish catches. The data from the two Fishing Log sources (trip details and catch estimates) was linked by matching unique identifiers: Canadian Fishing Vessel (CFV) identifier, trip (date landed), log identifier (last 6 characters of variable LOGCODE), and sheet/set identifier (last 9 characters of variable ESTIMATE_KEY).

A perusal of the set by set Commercial Landings and Fishing Log data files demonstrated that these data could not be fully matched below the trip level. Differences in data processing caused too much of the detailed set by set information (catch breakdown by and within date caught) to diverge. Hence the Fishing Log and Commercial Landings data for each year were linked according to CFV and trip (date landed), with the set characteristics retained according to the Commercial Landings data.

The presence or absence of catch data for each species within a trip from Commercial Landings and Fishing Log data sources was used to discriminate trips according to the following criteria:

0. Species were identified in the Fishing Log data while the Commercial Landings indicated entirely unspecified flounder. The Fishing Log data could also include unspecified flounder.

1. Both Commercial Landings and Fishing Log data identified species, but the Commercial Landings indicated one species plus unspecified flounder while the Fishing Log data indicated the same Commercial Landings species plus another named species.

2. Species were identified by both Commercial Landings and Fishing Log data, but the species were not the same and no unspecified flounder was indicated in the Fishing Log data. Two possibilities:

    a) Both data sources agreed except the Commercial Landings included some unspecified flounder in addition to the same named species as recorded in the Fishing Log data.

    b) A single identified species in both the Fishing Logs and Commercial Landings that were not the same species, plus unspecified flounder in the Commercial Landings. Typically this would be plaice in the Fishing Log data and witch plus unspecified in the Commercial Landings.

3. Flatfish (whether identified by species or not) in the Commercial Landings data but not the Fishing Log data. Either the Fishing Logs attributed the catch to another species (such as unspecified groundfish), no Fishing Log was submitted, or the Fishing Log was not processed by DFO.

4. Both Commercial Landings and Fishing Log data indicated unspecified flounder only.

5. Species were identified by both Commercial Landings and Fishing Log data, but the species were not the same and no unspecified flounder was indicated in the Commercial Landings data.

6. No CFV was provided in the Commercial Landings data to match with a CFV in the Fishing Log data.

7. The same, identified species are present in both Commercial Landings and Fishing Log data sources. Note both sources could also contain unspecified flounder (e.g. witch and unspecified flounder). No check was made of whether the two data sources had similar proportions of species.

8. Species were identified in the Commercial Landings while the Fishing Log data indicated unspecified flounder only.

The Commercial Landings data was used as the source of the total catch for our modified landings database because it has undergone fairly extensive auditing, editing

and processing that has not been attempted for the Fishing Log data. The Fishing Logs are entered mostly unedited except for coding, and are not required to be submitted by much of the fishery. Hence the Commercial Landings data should represent all the fish landed (even if misidentified) but the Fishing Logs will not. It should also be noted that despite the profusion of unspecified flounder in the Commercial Landings database where the Fishing Log database names species, it is still far commoner for the Commercial Landings database to name the species while the Fishing Log database does not. The Fishing Log database was used to provide an estimated catch by species for CFV/trip blocks of data, while the Commercial Landings database provided the catch by species to the level of set. The Fishing Log estimates were then used to represent relative proportions of species for a trip as a whole, with the Commercial Landings providing the total landings for the trip. This gave us a representation of flatfish landings according to both data sources.

EFFORT DATA

For each major fishery (4Vn American plaice Danish seiners, 4Vc plaice and yellowtail Danish seiners and tonnage class 1-3 otter trawlers, 4X plaice, yellowtail and winter flounder tonnage class 1-3 otter trawlers), we produced yearly directed subtrip catch per hour plots from both official and adjusted landings data to compare apparent catch rate trends between data sources. Within each fishery, we selected for vessels that had directed for the given flatfish species in at least 4 consecutive years since 1992, and had at least 10 sets each year. Determination of a directed subtrip required that the 'target' species represent over 50% of the subtrip (a subtrip is usually a day, but will be a partial day if the vessel changed area).

Preliminary Results and Dependent Methods

Table 1 summarizes the percent of total flatfish landings represented by each classification descriptor (referred to as Types) for 1992-97. Species identification in the Fishing Log database, where unspecified flounder are entered in the Commercial Landings database, can account for up to 42% (combining Type 0 and 1) of landings for a given year. This portion has consistently declined since 1994, with 1997 at 16%. For the purpose of potentially reconstructing landings only Types 0 and 1 seem immediately relevant and resolvable. In both cases, identified species from the Fishing Logs can be substituted for unspecified flatfish in the Commercial Landings, without making any assumptions regarding conflicts.

No attempt was made to resolve Type 6 data, in which the Fishing Log database has flatfish landings for a CFV not found in the Commercial Landings, since it was an insignificant component of the identification problem (these log estimates peaked at 3% of total Commercial Landings in 1995, and haven't recurred since). Spot checking indicated that some of these data were coded as non-flatfish groundfish species, and some

were entered in the Commercial Landings database without associated CFV's. These catches represented very little of the fishery in most (unadjusted landings) or all (adjusted landings) years (see Table 2).

Comparison of a random selection of Type 3 Commercial Landings trips with the non-flatfish Fishing Log database indicated that some of the unmatched Fishing Log data was due to recording flatfish bycatch as unspecified groundfish in Fishing Logs or during processing (typically flatfish bycatch in cod/haddock/pollock/redfish fisheries). The amount of landings affected is not minor (13-35% of flatfish Commercial Landings for 1992-97).

The nature of disagreements between Commercial Landings and Fishing Log databases are illustrated in Table 3, in which landings and log estimates for Type 2 and 5 data are summarized. Most of the discrepancies in 4X/5Y involve plaice designated in the Fishing Log database coded as witch in the Commercial Landings data. Due to the greater value of witch flounder relative to plaice, it seems likely that the Commercial Landings database is much closer to reality than the Fishing Log database in this respect. In 4VW, on the other hand, it is likely that a great deal of unspecified flounder in the Commercial Landings database should be plaice, since 'flounder' is the common term for plaice in this area. The differences between Commercial Landings and Fishing Log estimates of other named species are minor. Examining this data by unit areas within stock units showed that most of the 4VW Type 2 and 5 data came from 4Vc.

To portray the relevance of the most easily resolvable Type 0 and 1 components of the unidentified flatfish in the Commercial Landings, a dataset of 'adjusted' Commercial Landings was derived by substituting for species non-identification using Fishing Log data. The data as it exists in the official Commercial Landings was not changed for Types 2-8. The unspecified flounder in the Commercial Landings for Type 0 and 1 sets was allotted to species according to the proportions of estimated catch by trip (summed over sets) in the Fishing Log database (including any unspecified flounder in the Fishing Log database). These revisions will misrepresent truly unspecified flounder in the original Fishing Logs if 'flounder' were erroneously coded as other species during Fishing Log data entry. This would represent a carryover from earlier years in which 'flounder' were automatically coded as plaice in some parts of 4V, for instance. It would cause problems if the generalization were misapplied to a non-plaice species. We don't know that this still occurs (officially the practice was discontinued prior to the 1990's).

Final Results and Discussion

The comparison between unadjusted Commercial Landings (for 1992-97 as compiled in Dec/98), and landings for which Type 0 and 1 data have been revised by reference to Fishing Log database, is shown in Table 4 and Figure 2. The differences by species between datasets are notable, and even the impression of species importance by year and stock area has changed. In 4VW, American plaice landings were much more

important from 1992 to 1996, and yellowtail landings were higher during 1993-1995. In 4X/5Y the apparent landings of all species increased substantially, to the extent that American plaice would no longer be regarded as relatively inconsequential for the area. Prior to this review it was thought that, because witch flounder was considerably more valuable than other flatfish species, it was unlikely to be encountered as unspecified flounder. These results suggest that 4X/5Y witch landings have been substantially under-reported in the Commercial Landings due to coding as unspecified flounder.

The Commercial Landings database listed 30-60% of landings as unspecified flounder (Table 4). Using the Fishing Log database to substitute species identifications for this data reduces the percentage of unspecified flounder to between 10-40%, and under 15% since 1994. The catch of unspecified flounder in either dataset declined throughout 1992-1996. The last year examined, 1997, breaks this trend with an increase in the occurrence of unspecified flounder, both in absolute terms and proportionally to total flatfish landings.

In 4V, plaice are commonly called 'flounder', a label that would generally be coded 'unspecified flounder' in the Commercial Landings dataset. If 4V unspecified flounder in the Commercial Landings were accepted as being plaice for Type 2 data, the adjustments would reduce the unspecified portion of the landings to 6-8% of the catch for recent years (1995-97).

A more detailed picture of the impact of adjusting the unspecified flounder for Fishing Log identification of species can be discerned by plotting the locations of adjusted (Type 0 and 1 data only) and unadjusted landings by year for each species (Figures 3a-e, including unspecified flounder). Almost all of the flatfish landings data (about 97%) are associated with latitude and longitude co-ordinates (Table 5). Landings of unspecified flounder are much likelier to be associated with approximate locations (up to 26% in 1994) than an identified flatfish species. The largest percentage of landings with only approximate locations for an identified species was winter flounder in 1993 (12%).

Catch distributions of American plaice (Figure 3a) show the greatest divergence between Commercial and adjusted landings, with the adjusted landings portraying a generally consistent existence of fisheries in 4Vn, the southeast corner of Banquereau (4Vs), and western 4X/5Y. Over the period for which we could revise catches, some trends can be noted. An increase in 4V catches and a decline in western 4X/5Y catches is apparent from the adjusted Landings. The Commercial Landings present a dubious pattern of strictly western 4X/5Y catches in 1992, the complete absence of a fishery in 1993, then a much smaller fishery than indicated by the adjusted landings in all areas since 1994. The extreme differences between Commercial and adjusted landings data raises the question of whether or not the adjusted landings are a reasonable reflection of the plaice fisheries, or if instead there is a problem with unquantifiable portions of non-plaice 'flounder' (e.g. yellowtail flounder in 4V, or winter flounder in 4X) being blanket-coded as plaice during data entry.

Distributions of yellowtail, winter and witch flounders in the adjusted landings data parallel those of the official catch statistics (Figures 3b-d). The main effect of the adjustments has been to increase landings for each species generally. No drastic biases in locations between plots are evident as for American plaice, although the adjusted landings of witch flounder are much more enhanced relative to the Commercial Landings in western 4X/5Y than in 4VW.

The distribution of the Commercial Landings unspecified flounder and adjusted landings still-unspecified flounder catches (Figure 3e) gives an indication of the potential usefulness of revising the Commercial Landings of unspecified flounder according to Fishing Log identification of species. In 1992 the adjustments were of little consequence for any fishery outside 4Vn. But since 1993 the reduction in unspecified flounder by adjusting for Fishing Log data is pervasive throughout the Scotia-Fundy region.

If the rationale applied to adjust the unspecified flounder landings is valid, then the method would be worthwhile to correct for landings since 1993. Given the lack of effect outside 4Vn in 1992, and perhaps some potential for biasing interpretations as a result, we would not recommend making adjustments prior to 1993. Some Industry sources also maintain that the quality of Fishing Logs in general prior to 1993 is poor.

In addition to the possible impacts that adjusting flatfish species identification would have on Quota Monitoring and TAC allocations, these changes are also relevant to the determination of catch rate trends used in assessments. Appendix 1 demonstrates the difference in catch rates between Commercial and adjusted landings for the eight largest flatfish fishery components. The biggest affect of the adjusted landings on catch rates of historically consistent fishers is with respect to American plaice and yellowtail flounder, simply a result of having data where previously insufficient data existed to consider catch rates. Table 6 provides an overall summary of the changes in total and directed landings between Commercial and adjusted datasets. Note that set-specific determinations of directed fishing for the adjusted landings were used to generate the table, but that subtrip-specific determinations were used to achieve catch rate analyses in parallel with the Commercial Landings data (slightly more of the adjusted landings would be considered directed by subtrip than by set). If the adjustments are valid, this represents a major improvement in the use of catch rates to assess these species. Past assessments were unable to consider fishing history to select vessels due to data loss, whereas with the adjusted data this could be achieved for post-1991 data. It might also be possible to conduct catch rate analyses on a set by set basis if only the historical fishers are included, but such an analysis would require matching log data to Commercial Landings data at the set level, a major task. This would eliminate the confounding potential of non-directing sets within a day due to determination of target species by subtrips, not sets, in the official landings.

TABLE 1. COMPARISON OF FLATFISH SPECIES IDENTIFICATION BETWEEN THE COMMERCIAL LANDINGS (CL) AND FISHING LOG DATABASES

Values in table are percent of landings.

Likely Data Status	resolvable	resolvable	unresolved	unresolved	unresolved	unresolved	unresolved	OK	OK
Classification	0	1	2	3	4	5	6	7	8
1992	16.6	4.1	2.1	34.7	17.0	1.7	1.7	17.7	2.4
1993	37.2	5.2	2.2	31.2	7.6	3.0	2.0	10.6	0.9
1994	36.8	5.2	3.6	24.9	4.6	10.6	2.5	11.0	0.8
1995	26.4	4.9	2.8	16.5	4.7	15.1	2.9	25.3	1.5
1996	20.0	2.3	1.8	13.2	6.7	19.2		35.4	1.5
1997	14.8	1.4	1.6	15.1	12.0	20.2		31.8	3.3

CLASSIFICATION KEY

	COMMERCIAL LANDINGS	FISHING LOG
0	unspecified flounder only	identified species (+/- unspecified flounder)
1	one given species + unspecified flounder	same given species + another identified species
2	one or more given species + unspecified flounder	a) no unspecified flounder; same given species
"	"	b) no unspecified flounder; different given species + another identified species
3	flatfish	no flatfish or no fishing log
4	unspecified flounder only	unspecified flounder only
5	one or more given species	one or more different given species (+/- unspecified flounder)
6	no CPV	cannot be linked to Commercial Landings
7	one or more given species, +/- unspecified flounder	same given species, +/- unspecified flounder
8	one or more given species, +/- unspecified flounder	unspecified flounder only

TABLE 2. FLATFISH IN LOG DATABASE NOT DIRECTLY LINKED TO THE COMMERCIAL LANDINGS DATABASE

Tons landed in Log database not matched to Commercial Landings database

	PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH
1992	26	33	14	46	65
1993	45	22	2	36	26
1994	62	5	0	14	9
1995	22	8	2	3	19
1996	24	2	0	1	1
1997	1	0	1	2	0

-will include any Commercial Landings for which CFV dropped

Percent of Commercial Landings

1992	5.6%	2.2%	2.5%	2.6%	1.1%
1993	47.8%	1.3%	0.7%	4.0%	0.5%
1994	42.2%	0.4%	0.0%	2.2%	0.2%
1995	6.2%	1.0%	0.2%	0.6%	0.9%
1996	3.6%	0.3%	0.0%	0.1%	0.0%
1997	0.1%	0.2%	0.1%	0.3%	0.0%

Tons landed from Commercial Landings

PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH
468	1491	570	1742	5857
93	1678	346	895	4942
147	1130	523	651	3597
355	869	924	605	2094
660	539	938	730	1448
1044	113	782	714	1248

Percent of Adjusted Landings

1992	1.6%	1.9%	1.6%	2.1%	1.7%
1993	2.3%	1.1%	0.3%	2.6%	1.5%
1994	4.3%	0.3%	0.0%	1.1%	0.9%
1995	1.8%	0.8%	0.1%	0.4%	4.0%
1996	1.8%	0.3%	0.0%	0.1%	0.2%
1997	0.1%	0.2%	0.1%	0.3%	0.0%

Tons landed from Adjusted Landings

1607	1674	887	2186	3770
1912	2031	884	1370	1757
1464	1409	994	1252	930
1215	1085	1210	856	481
1312	590	1184	903	325
1521	132	892	774	583

TABLE 3. COMMERCIAL AND ADJUSTED LANDINGS FOR TRIPS NOT RECONCILED.

COMMERCIAL LANDINGS

	4VW					4X/5Y				
	PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH	PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH
1992	0	643	211	1	271	22	11	285	144	35
1993	0	417	.95	0	350	0	10	153	54	17
1994	13	439	57	0	242	23	49	217	241	36
1995	108	185	35	0	125	8	81	167	421	35
1996	255	226	63	3	117	11	107	187	474	27
1997	236	48	72	2	313	68	23	158	376	6

ADJUSTED LANDINGS

	4VW					4X/5Y				
	PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH	PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH
1992	188	695	215	0	28	173	50	196	61	18
1993	347	399	70	0	46	73	13	127	19	1
1994	297	373	64	2	15	213	35	234	79	3
1995	226	188	19	0	19	339	29	203	117	25
1996	343	197	56	0	67	462	39	219	85	3
1997	550	58	47	0	16	339	26	165	89	12

The log database trip proportions by species were applied to Commercial Landings flatfish totals by set to obtain log-adjusted landings for class 2 and 5 data.

TABLE 4. FLATFISH LANDINGS ADJUSTED BY REPLACING UNSPECIFIED FLOUNDER IN THE COMMERCIAL LANDINGS WITH PROPORTIONS OF NAMED OR UNSPECIFIED FLOUNDER IN THE FISHING LOG DATABASE.

4VW

		PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH	TOTAL	PERCENT UNSPECIFIED
Commercial	1992	53	1372	4	912	1883	4225	44.6%
	1993	84	1625	2	520	1656	3886	42.6%
	1994	66	1035	3	260	1408	2771	50.8%
	1995	328	736	0	299	921	2284	40.3%
	1996	596	390	4	326	543	1858	29.2%
	1997	895	77	2	298	677	1949	34.7%
Adjusted	1992	479	1390	7	922	1425	4223	33.8%
	1993	778	1864	3	527	714	3886	18.4%
	1994	836	1219	3	284	430	2771	15.5%
	1995	843	921	0	303	216	2284	9.5%
	1996	953	396	4	332	173	1858	9.3%
	1997	1206	87	2	306	349	1950	17.9%

4X/5Y

		PLAICE	YELLOWTAIL	WINTER	WITCH	UNSPEC. FLATFISH	TOTAL	PERCENT UNSPECIFIED
Commercial	1992	414	119	566	830	3974	5903	67.3%
	1993	9	53	344	375	3287	4069	80.8%
	1994	82	96	520	390	2189	3277	66.8%
	1995	27	133	924	306	1173	2563	45.8%
	1996	64	149	934	404	905	2456	36.8%
	1997	150	36	780	415	571	1952	29.2%
Adjusted	1992	1128	283	880	1264	2344	5900	39.7%
	1993	1134	167	881	843	1044	4069	25.7%
	1994	628	190	991	968	500	3277	15.3%
	1995	372	164	1210	553	264	2563	10.3%
	1996	359	194	1181	571	152	2456	6.2%
	1997	315	45	890	469	234	1953	12.0%

SUMMARY

	COMMERCIAL LANDINGS			ADJUSTED LANDINGS		
	UNSPEC. FLATFISH	TOTAL FLATFISH	PERCENT UNSPECIFIED	UNSPEC. FLATFISH	TOTAL FLATFISH	PERCENT UNSPECIFIED
1992	5857	10128	57.8%	3770	10123	37.2%
1993	4942	7955	62.1%	1757	7955	22.1%
1994	3597	6049	59.5%	930	6049	15.4%
1995	2094	4847	43.2%	481	4847	9.9%
1996	1448	4314	33.6%	325	4314	7.5%
1997	1248	3901	32.0%	583	3902	14.9%

TABLE 5. SUMMARY OF PLOTTABLE (SPECIFIC LOCATION) VERSUS UNPLOTTABLE (GENERAL LOCATION) ADJUSTED LANDINGS.

	General Location	Specific Location	Percent Data Loss for Mapping
1992 Plaice	47	1561	3%
Yellowtail	41	1633	3%
Witch	69	2117	3%
Winter	21	866	2%
Unspecified	554	3215	17%
1993 Plaice	93	1819	5%
Yellowtail	29	2002	1%
Witch	45	1325	3%
Winter	97	787	12%
Unspecified	278	1479	19%
1994 Plaice	40	1424	3%
Yellowtail	24	1385	2%
Witch	27	1225	2%
Winter	16	978	2%
Unspecified	191	739	26%
1995 Plaice	26	1189	2%
Yellowtail	13	1072	1%
Witch	4	852	0%
Winter	9	1201	1%
Unspecified	83	397	21%
1996 Plaice	35	1277	3%
Yellowtail	5	585	1%
Witch	5	897	1%
Winter	1	1183	0%
Unspecified	7	318	2%
1997 Plaice	28	1493	2%
Yellowtail	3	130	2%
Witch	12	763	2%
Winter	0	891	0%
Unspecified	19	564	3%

TABLE 6. Summary of directed fishing for flatfish according to the Commercial and Adjusted Landings catch data. A catch of a species is considered to have been directed for if the species represents 50% or more of the total catch by subtrip (official landings) or set (adjusted landings).

		Commercial Landings			Adjusted Landings		
		Total Landings	Directed Landings	Percent Directed	Total Landings	Directed Landings	Percent Directed
American plaice	1992	468	250	53%	1607	952	59%
	1993	93	0	0%	1912	1159	61%
	1994	147	70	48%	1464	1027	70%
	1995	355	300	85%	1215	919	76%
	1996	660	566	86%	1312	1026	78%
	1997	1044	887	85%	1521	1228	81%
Yellowtail flounder	1992	1491	1303	87%	1674	1392	83%
	1993	1678	1531	91%	2031	1792	88%
	1994	1130	1007	89%	1409	1165	83%
	1995	869	761	88%	1085	927	85%
	1996	539	423	78%	590	438	74%
	1997	113	65	57%	132	81	61%
Winter flounder	1992	570	399	70%	887	560	63%
	1993	346	165	48%	884	508	57%
	1994	523	280	54%	994	545	55%
	1995	924	615	67%	1210	688	57%
	1996	938	605	65%	1184	626	53%
	1997	782	426	54%	892	356	40%
Witch flounder	1992	1742	1049	60%	2186	1213	55%
	1993	895	614	69%	1370	819	60%
	1994	651	355	55%	1252	614	49%
	1995	605	367	61%	856	417	49%
	1996	730	457	63%	903	442	49%
	1997	714	351	49%	774	294	38%
Unspecified flounder	1992	5857	3353	57%	3770	2232	59%
	1993	4942	3384	68%	1757	1180	67%
	1994	3597	2567	71%	930	728	78%
	1995	2094	1560	74%	481	357	74%
	1996	1448	1082	75%	325	245	75%
	1997	1248	982	79%	583	479	82%

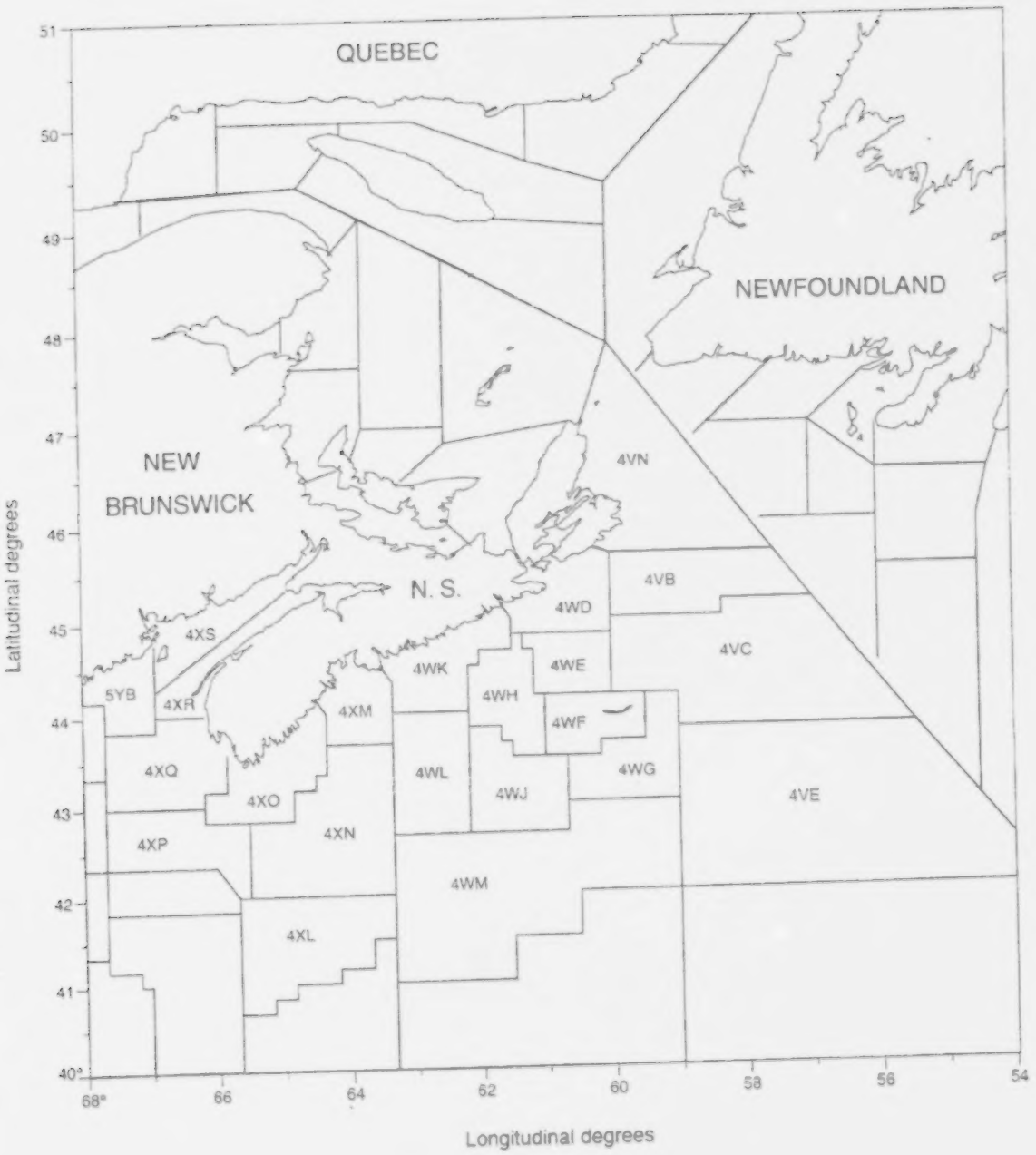


Figure 1. North Atlantic Fisheries Organization (NAFO) unit areas referred to in this paper.

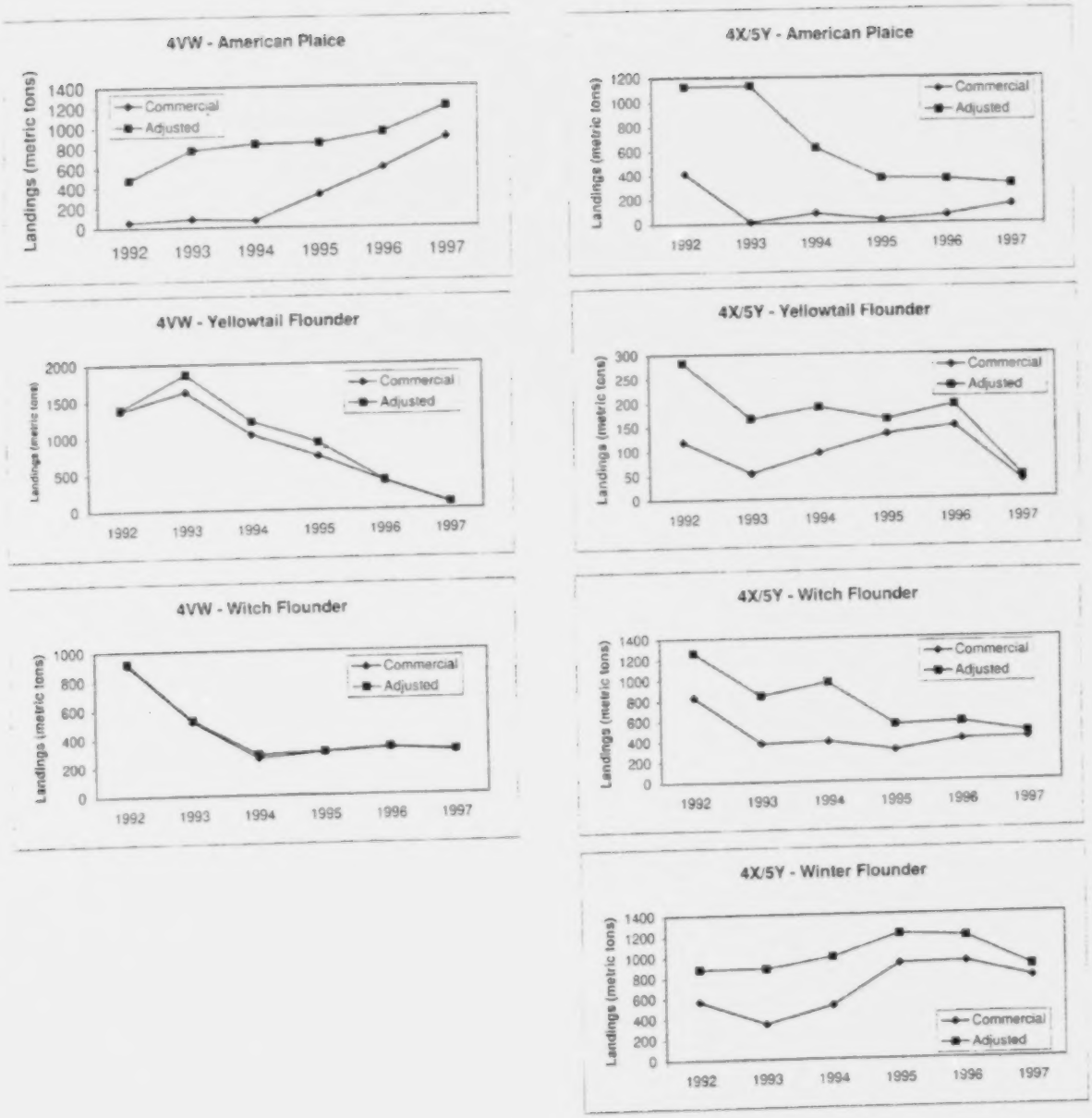


Figure 2. Comparison of Commercial and Adjusted Landings for American plaice, yellowtail flounder, witch flounder, and winter flounder for 1992-1997. Separate plots of 4VW and 4X/5Y Landings are intended to better reflect general fishery regimes. We don't plot the very minor landings (under 10 tons any year) of winter flounder in 4VW.

Figure 3a. Comparison of the distribution of Scotia-Fundy American plaice landings from the Commercial Landings and Fishing Log Adjusted Landings datasets.

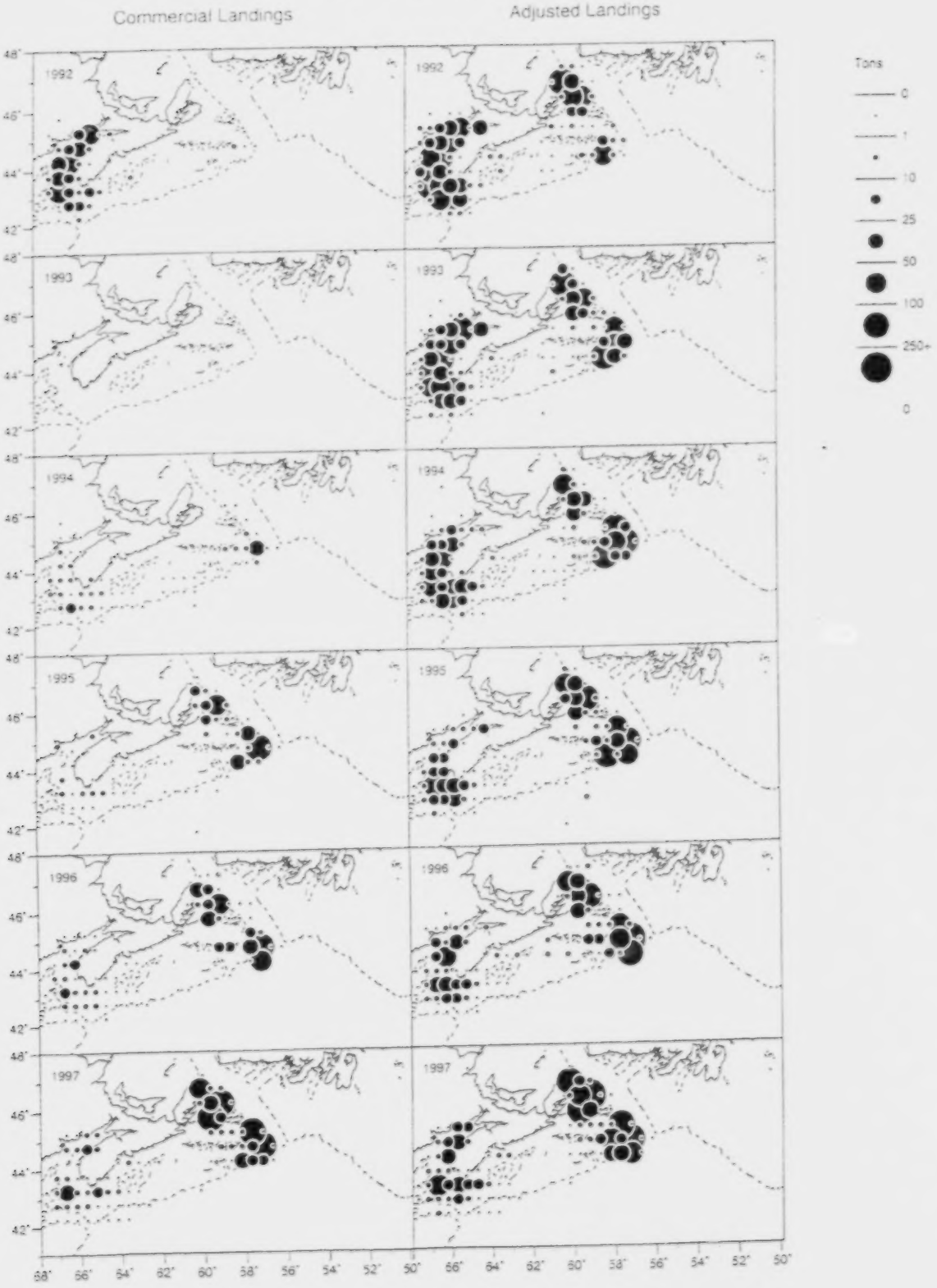


Figure 3b. Comparison of the distribution of Scotia-Fundy yellowtail flounder landings from the Commercial Landings and Fishing Log Adjusted Landings datasets.

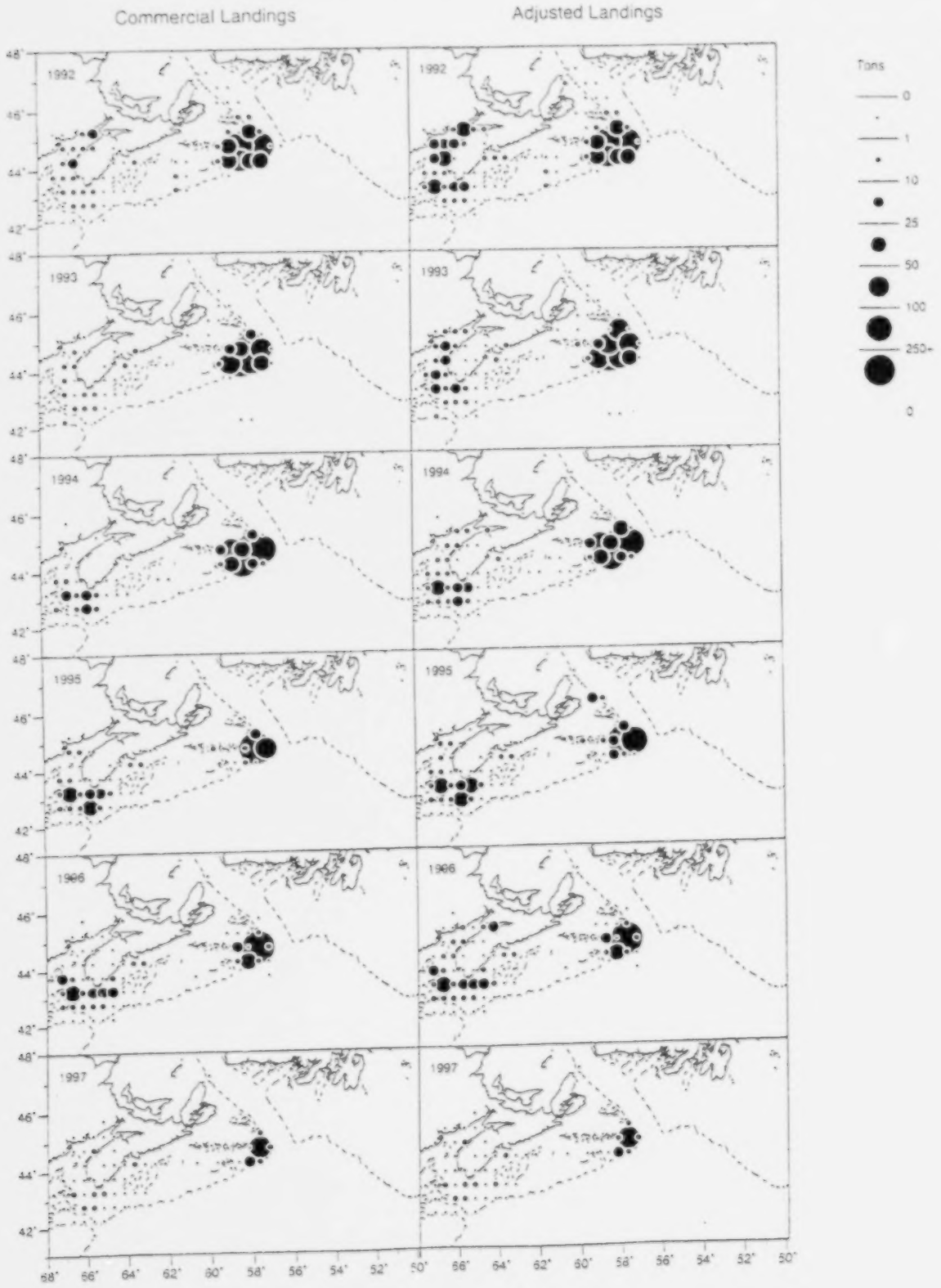


Figure 3c. Comparison of the distribution of Scotia-Fundy witch flounder landings from the Commercial Landings and Fishing Log Adjusted Landings datasets.

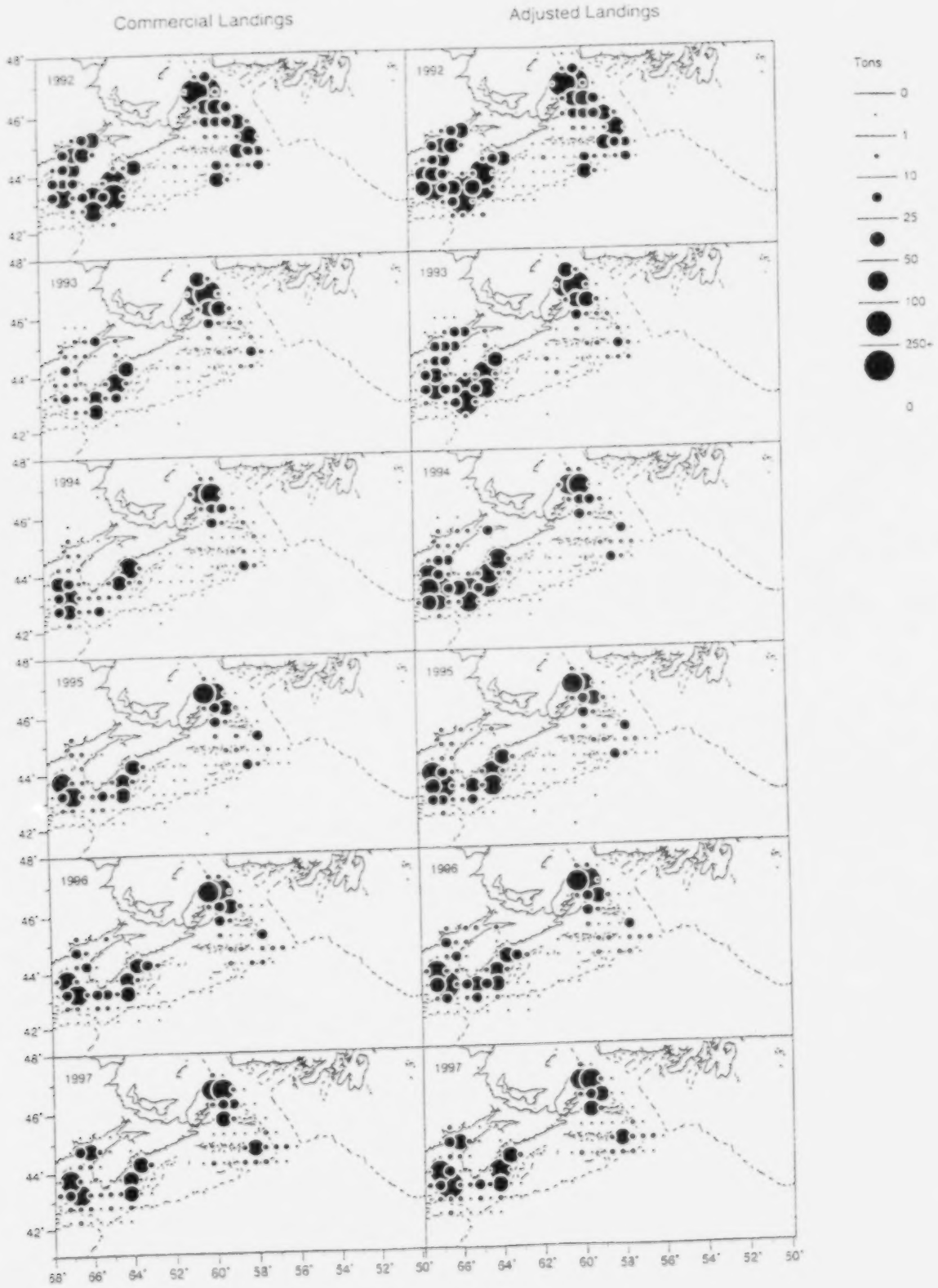


Figure 3d. Comparison of the distribution of Scotia-Fundy winter flounder landings from the Commercial Landings and Fishing Log Adjusted Landings datasets.

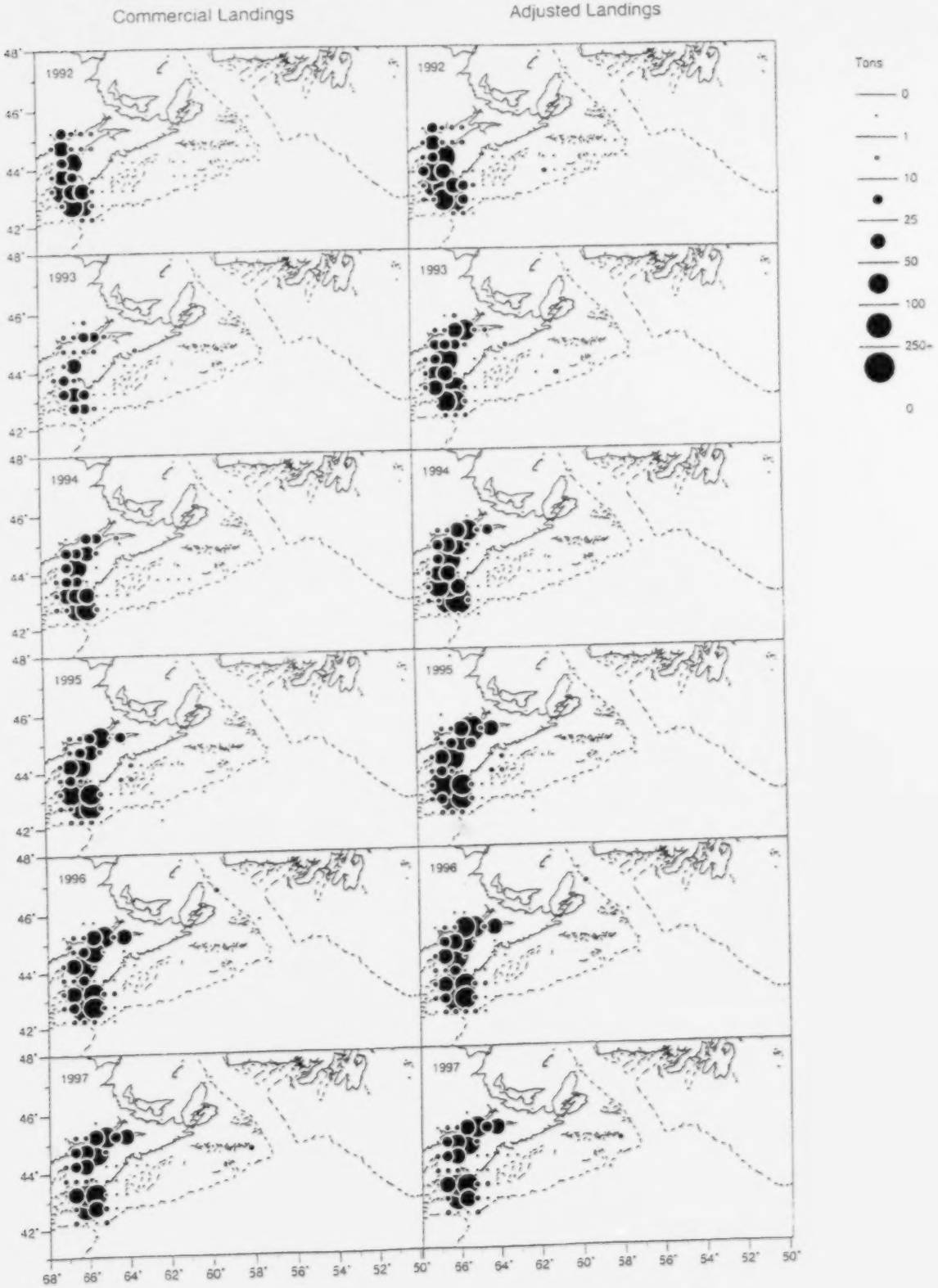
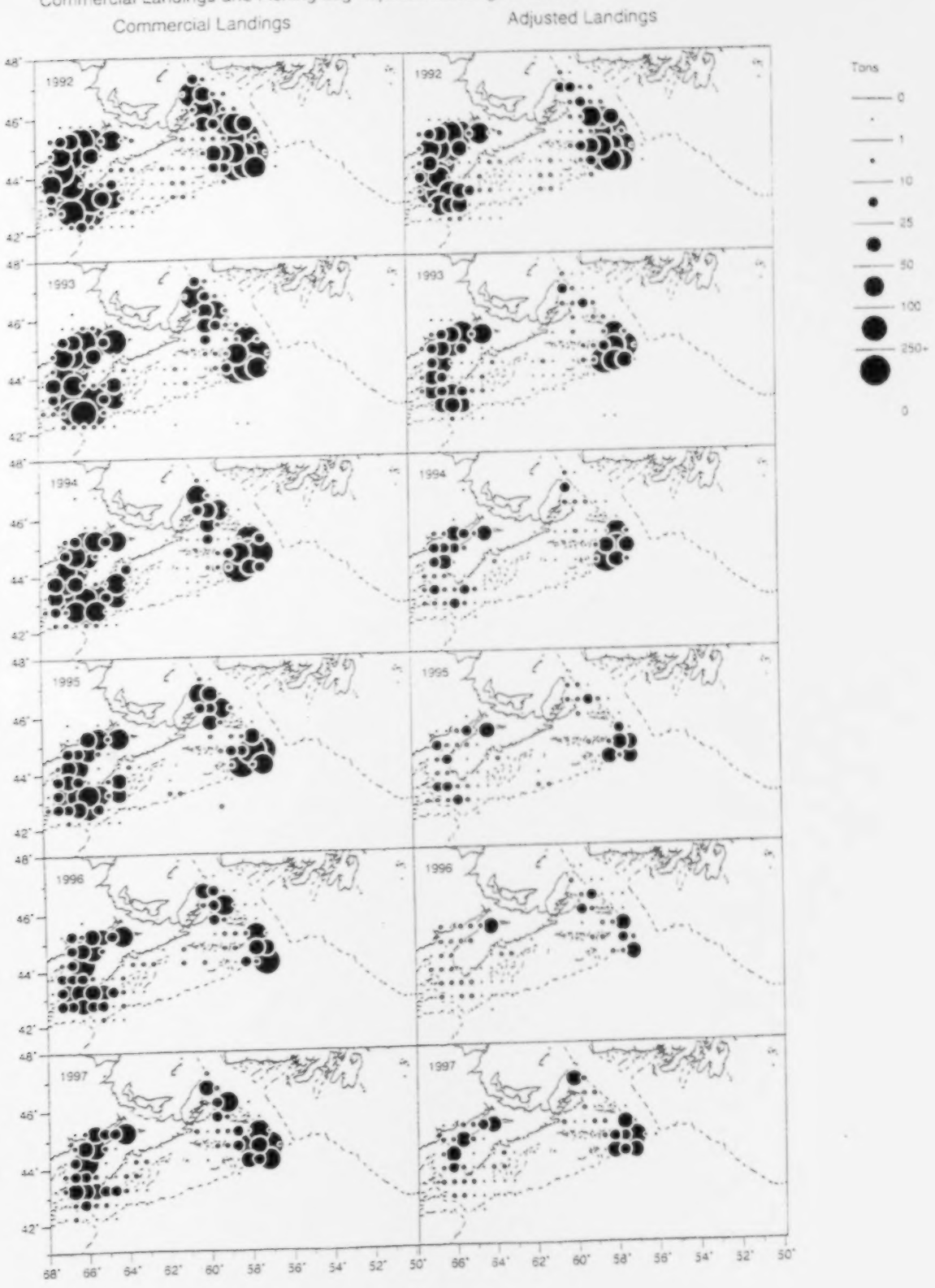
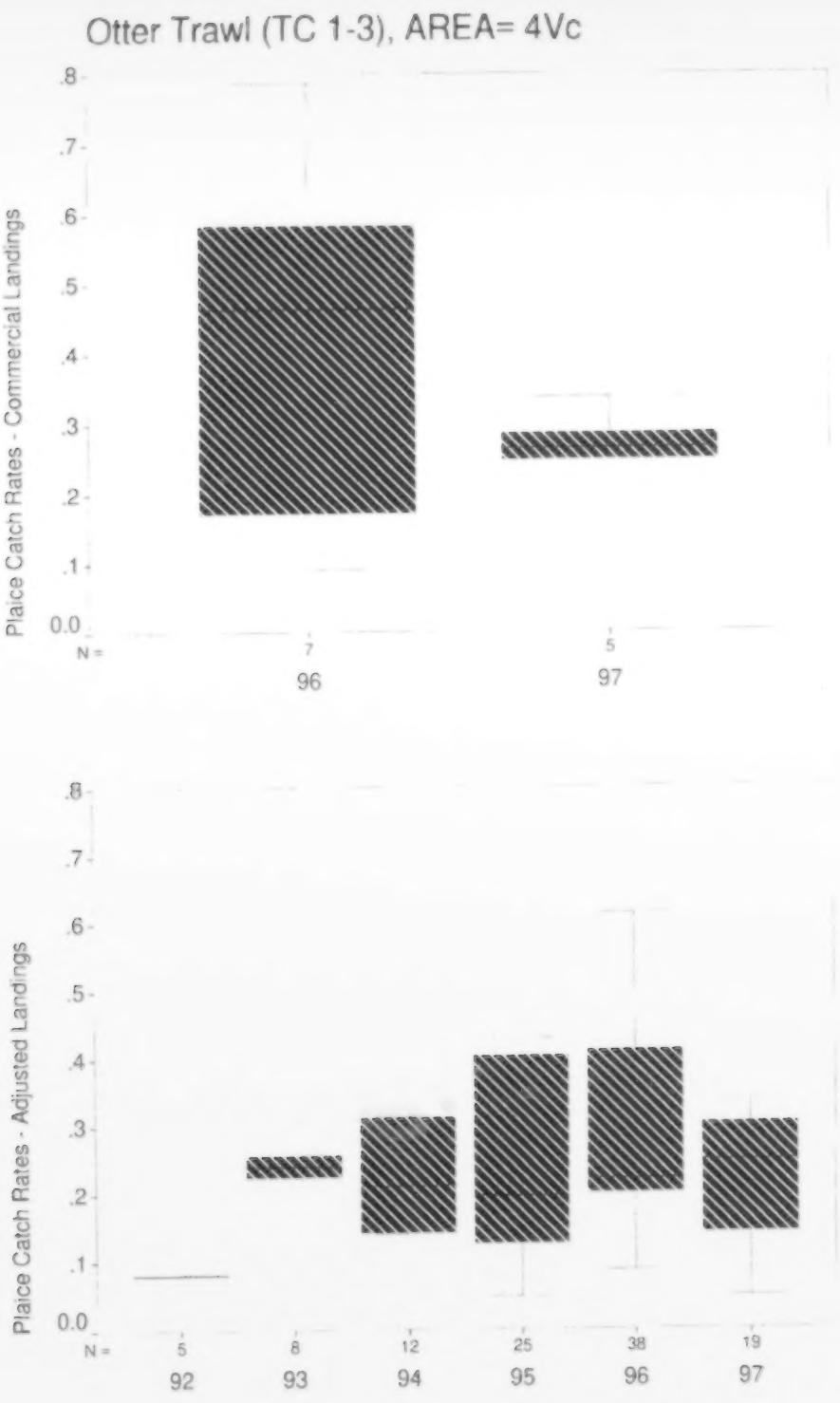
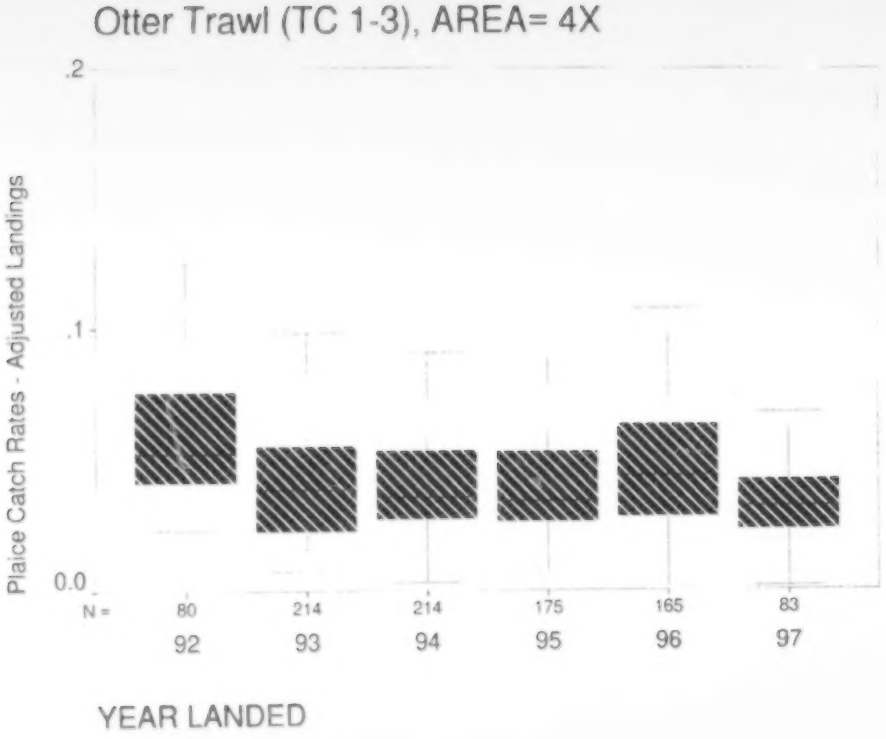


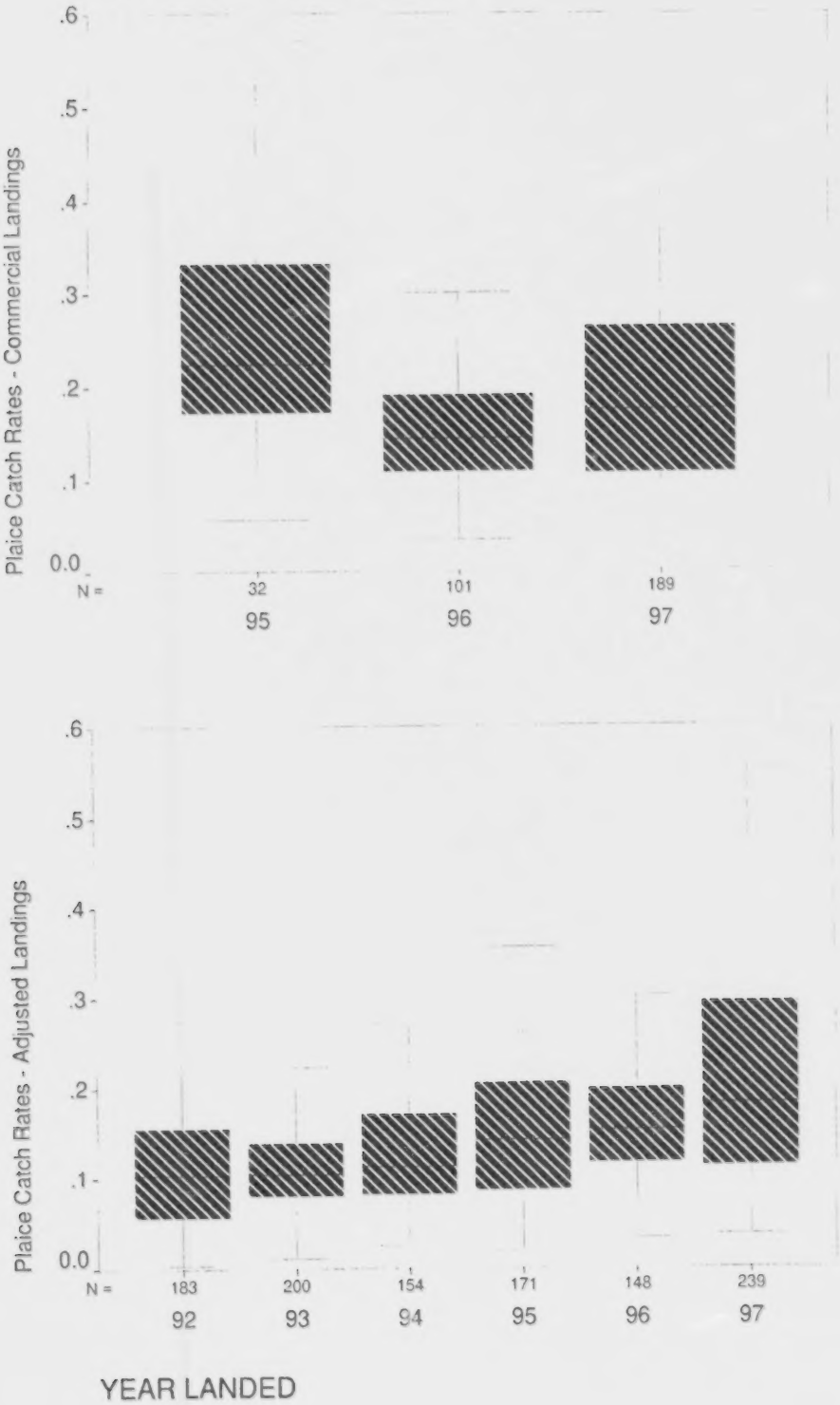
Figure 3e. Comparison of the distribution of Scotia-fundy unspecified flounder landings from the Commercial Landings and Fishing Log Adjusted Landings datasets.



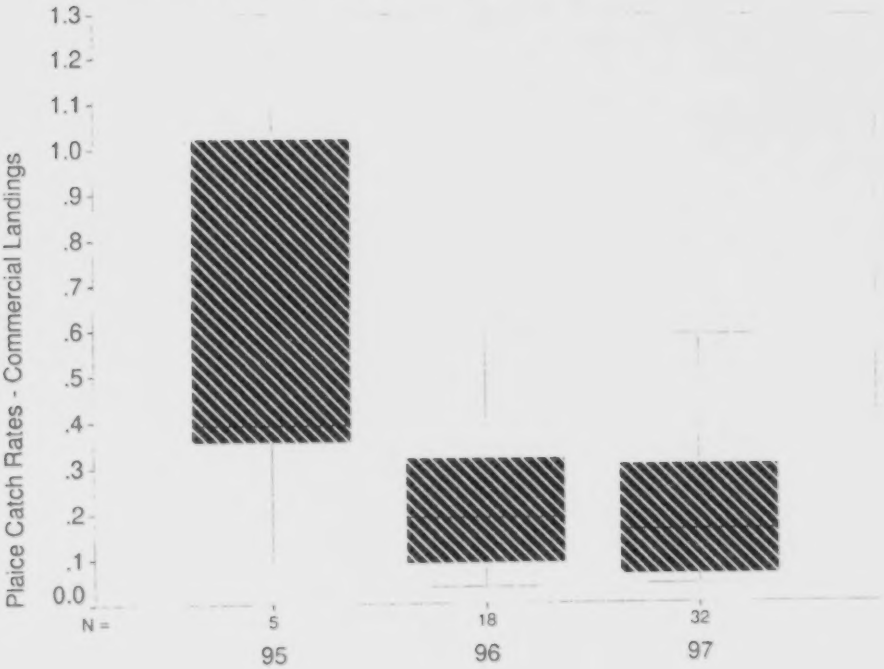
Appendix 1. Commercial catch rates (tons/hour) of major flatfish fishery components during 1992-1997.

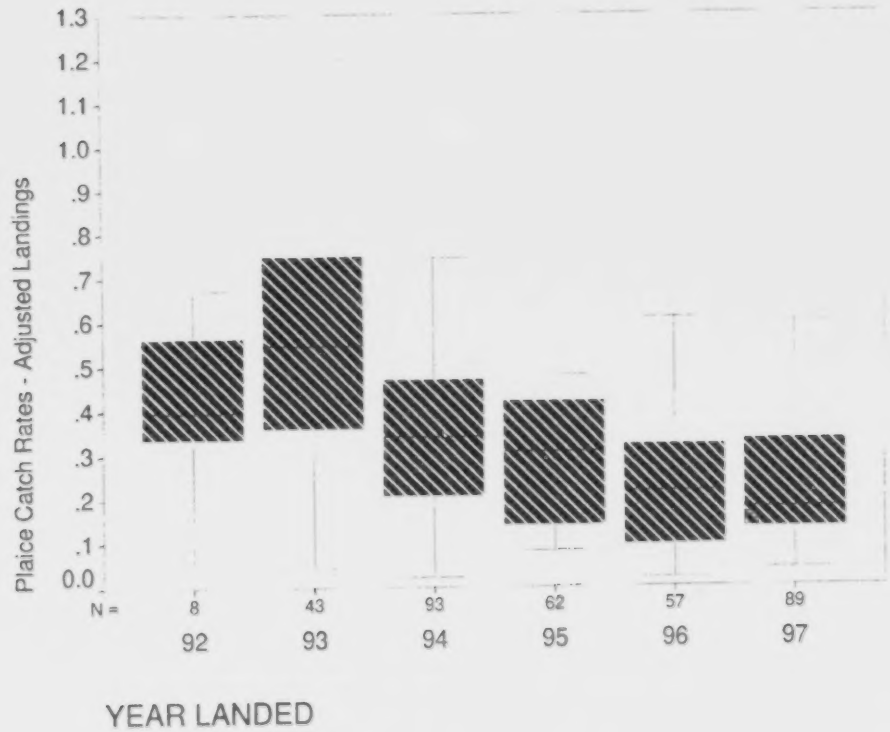

Otter Trawl (TC 1-3), AREA= 4Vc
Plaice Catch Rates - Commercial Landings
.8
.7
.6
.5
.4
.3
.2
.1
0.0
N =
7
5
96
97
Plaice Catch Rates - Adjusted Landings
.8
.7
.6
.5
.4
.3
.2
.1
0.0
N =
5
8
12
25
38
19
92
93
94
95
96
97
YEAR LANDED

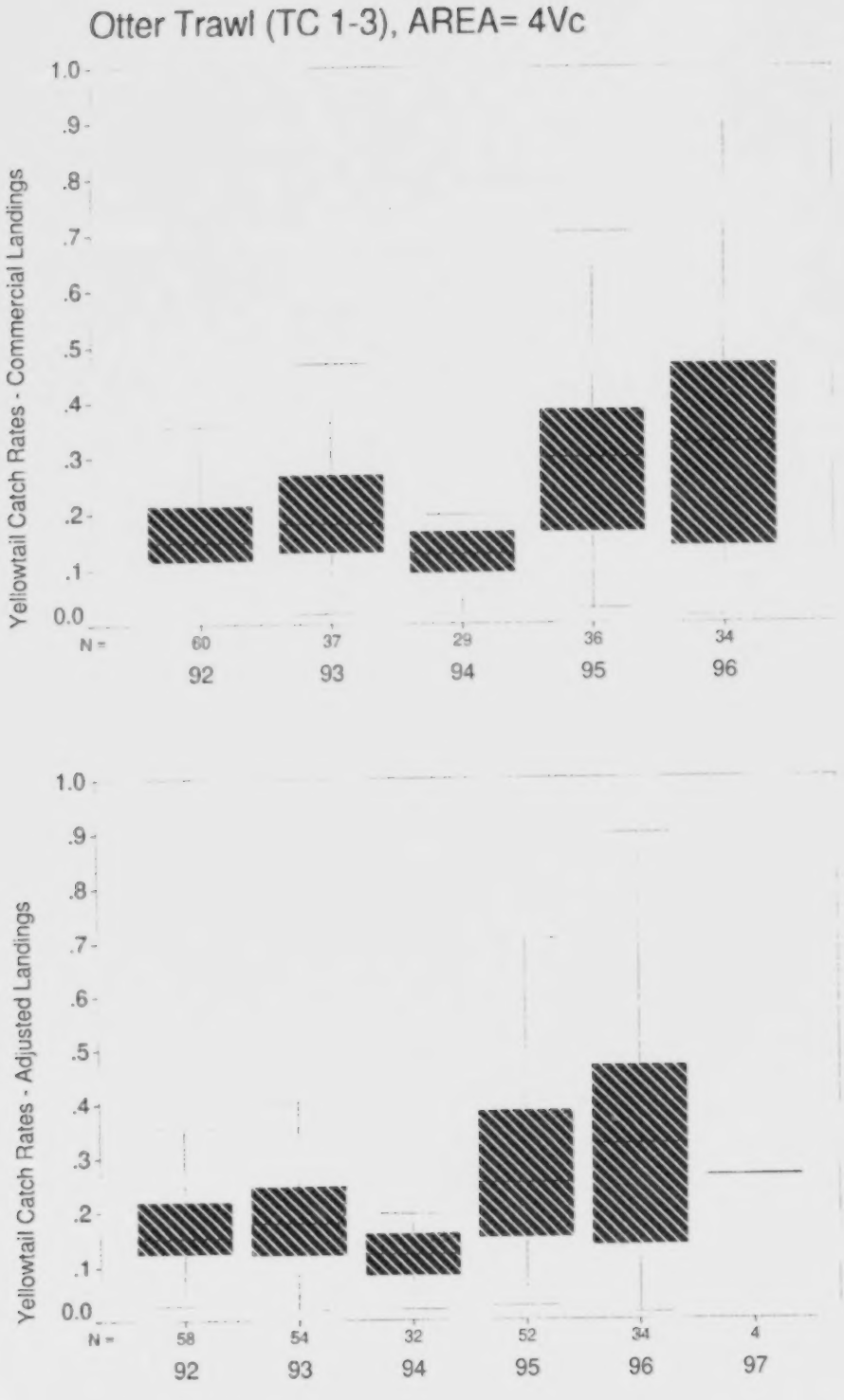

Otter Trawl (TC 1-3), AREA= 4X
Plaice Catch Rates - Adjusted Landings
.2
.1
0.0
N =
80
214
214
175
165
83
92
93
94
95
96
97
YEAR LANDED

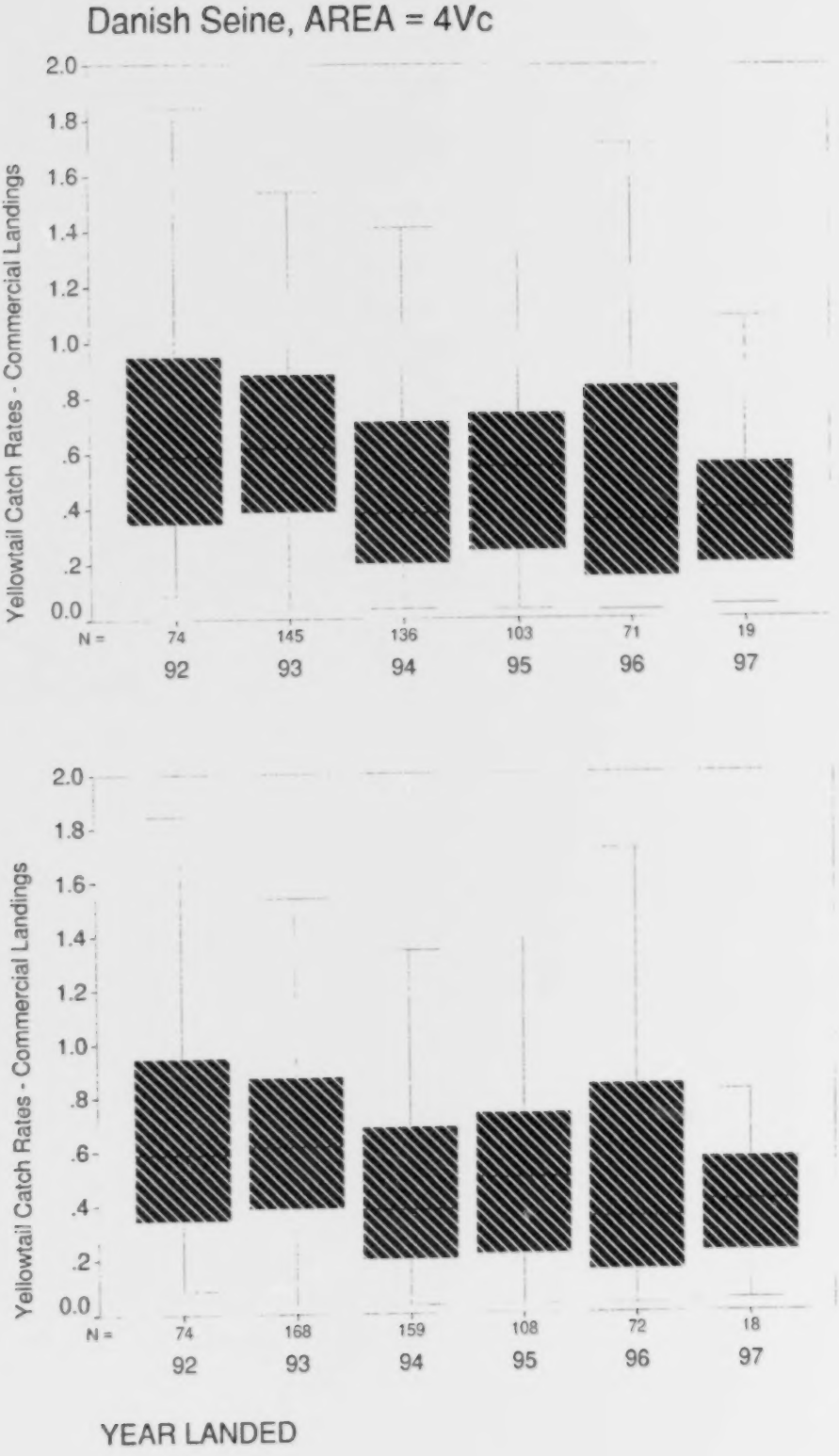

Danish Seine, AREA = 4Vn
Plaice Catch Rates - Commercial Landings
.6
.5
.4
.3
.2
.1
0.0
N =
32
101
189
95
96
97
Plaice Catch Rates - Adjusted Landings
.6
.5
.4
.3
.2
.1
0.0
N =
183
200
154
171
148
239
92
93
94
95
96
97
YEAR LANDED

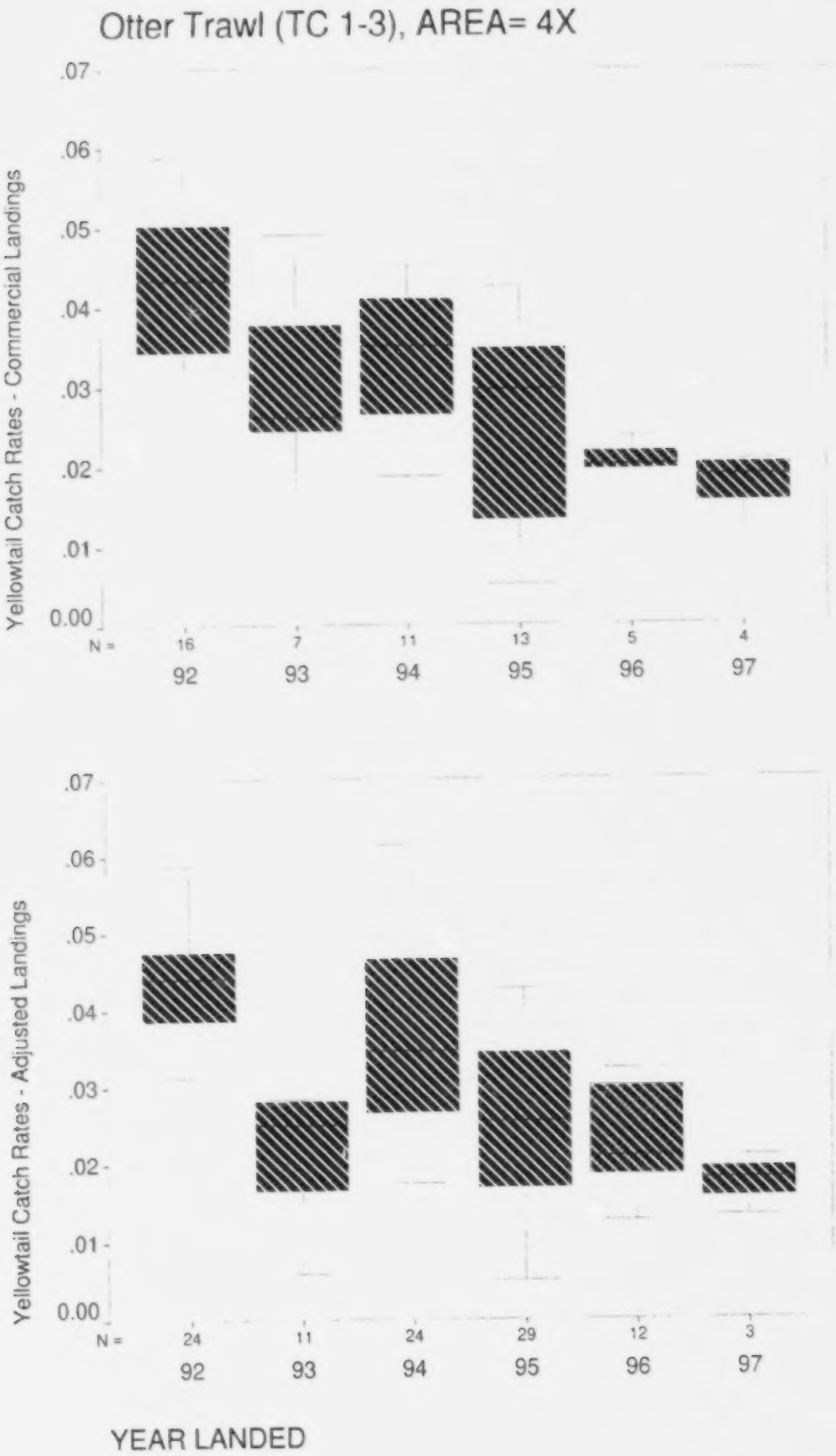
Danish Seine, AREA = 4Vc

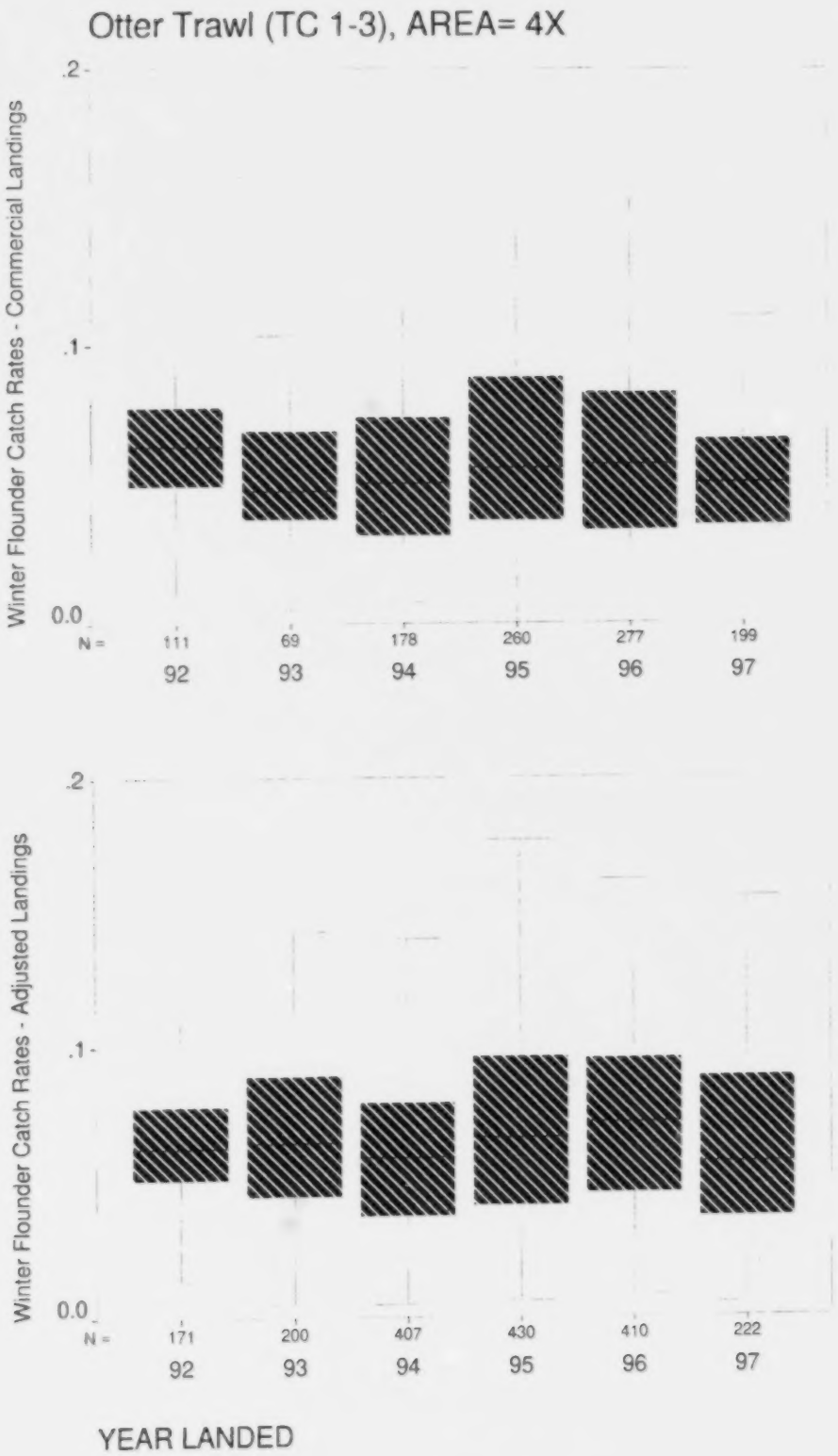





Otter Trawl (TC 1-3), AREA= 4Vc
Yellowtail Catch Rates - Commercial Landings
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0.0
N =
60
37
29
36
34
92
93
94
95
96
Yellowtail Catch Rates - Adjusted Landings
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0.0
N =
58
54
32
52
34
4
92
93
94
95
96
97
YEAR LANDED


Danish Seine, AREA = 4Vc
Yellowtail Catch Rates - Commercial Landings
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0.0
N =
74
145
136
103
71
19
92
93
94
95
96
97
Yellowtail Catch Rates - Commercial Landings
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0.0
N =
74
168
159
108
72
18
92
93
94
95
96
97
YEAR LANDED


Otter Trawl (TC 1-3), AREA= 4X
Yellowtail Catch Rates - Commercial Landings
.07
.06
.05
.04
.03
.02
.01
0.00
N = 16 7 11 13 5 4
92 93 94 95 96 97
Yellowtail Catch Rates - Adjusted Landings
.07
.06
.05
.04
.03
.02
.01
0.00
N = 24 11 24 29 12 3
92 93 94 95 96 97
YEAR LANDED


Otter Trawl (TC 1-3), AREA= 4X
Winter Flounder Catch Rates - Commercial Landings
.2
.1
0.0
N =
111
69
178
260
277
199
92
93
94
95
96
97
Winter Flounder Catch Rates - Adjusted Landings
.2
.1
0.0
N =
171
200
407
430
410
222
92
93
94
95
96
97
YEAR LANDED